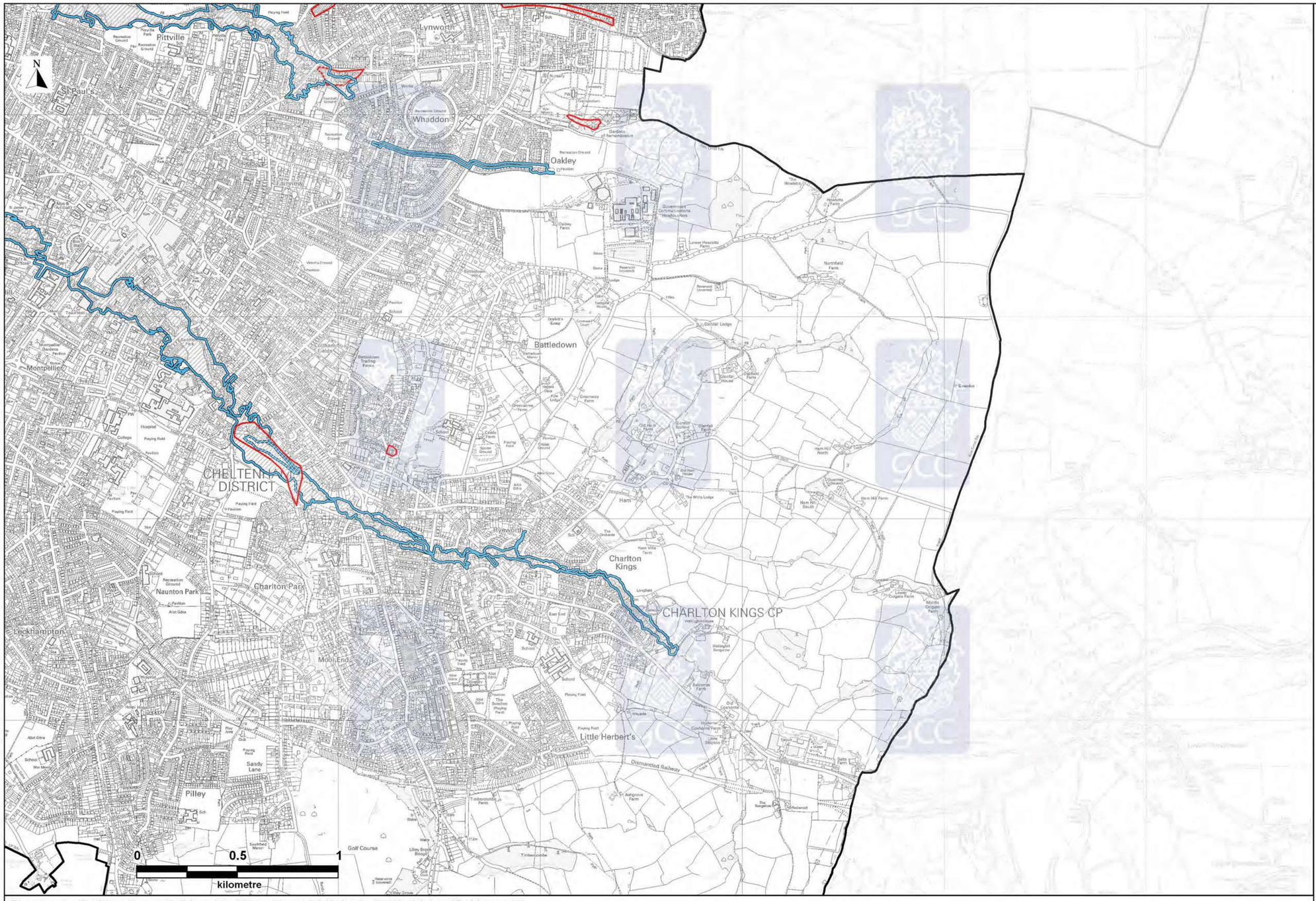
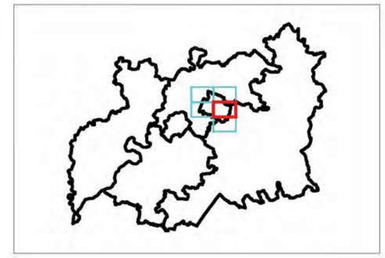


Location Plan:-



Legend:-

- Council Boundary
- July 1968
- July 2007

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Project:- GLOUCESTERSHIRE STRATEGIC FLOOD RISK ASSESSMENT

Tile E4:- HISTORIC FLOODING
CHELTENHAM BOROUGH COUNCIL

Drawn By	:- A J Bryan	Revision	-	Drawing Scale	:- 1:10,000	Drawing No.	:- WB/GLOS/DRAWING - 044	
Checked By	:- B L Dunn	Status		Sheet No.	:- 4 of 4	Date	:- 26 March 2008	
Approved By	:- J R Parkin		FINAL	Plot Scale	:- 1:1 @ A1	Issuing Office	:- Birmingham	

Rev.	By	Date	Description

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Appendix D

Greenfield Run-off Calculations

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.450
Area (ha)	1.000	Urban	0.000
SAAR (mm)	800	Region Number	Region 4

Results l/s

QBAR Rural	5.1
QBAR Urban	5.1
Q100 years	13.2
Q1 year	4.3
Q30 years	10.1
Q100 years	13.2

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Appendix E

Drawing:

476-003 – Drainage Strategy

LEGEND

- INDICATIVE SURFACE WATER SEWER
- INDICATIVE FOUL SEWER
- INDICATIVE HIGHWAY DRAIN
- INDICATIVE CUT-OFF/INTERCEPTION DRAIN/CHANNEL
- ON-SITE FLOOD EXCEEDANCE ROUTE
- EXISTING SURFACE WATER SEWER
- EXISTING FOUL SEWER

ATTENUATION POND

TOTAL CATCHMENT AREA	= 14.76ha
OPEN SPACE	= 7.91ha
DEVELOPED AREA	= 6.85ha
IMPERMEABLE AREA	= 3.76ha (55% IMPERMEABLE)

EXISTING GREEN FIELD RUN-OFF:

Qbar	= 35.0 l/s (5.1 l/s/ha)
Q1	= 29.45 l/s (4.3 l/s/ha)
Q30	= 69.18 l/s (10.1 l/s/ha)
Q100	= 90.42 l/s (13.2 l/s/ha)

Revisions

Project: Oakley Farm, Battledown Cheltenham

Client:

Robert Hitchins
The Complete Development Solution

Drawing: Drainage Strategy

Scale: 1:1,000 @ A1 | Date: 13/04/2019 | Drawn by: P.A.

Drawing No: 476-003 | Rev: -

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Drg.Status: PRELIMINARY

Appendix F

Micro-Drainage Simulations

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.500	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 3.767

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	1.255	4	8	1.255	8	12	1.257

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Model Details

Storage is Online Cover Level (m) 80.500

Tank or Pond Structure

Invert Level (m) 78.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	871.0	2.000	1733.0

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0242-3450-1700-3450
Design Head (m)	1.700
Design Flow (l/s)	34.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	242
Invert Level (m)	78.500
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.700	34.5	Kick-Flo®	1.135	28.4
Flush-Flo™	0.520	34.4	Mean Flow over Head Range	-	29.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum® as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.9	1.200	29.2	3.000	45.3	7.000	68.3
0.200	24.6	1.400	31.4	3.500	48.8	7.500	70.7
0.300	32.8	1.600	33.5	4.000	52.1	8.000	72.9
0.400	34.0	1.800	35.5	4.500	55.2	8.500	75.1
0.500	34.4	2.000	37.3	5.000	58.0	9.000	77.2
0.600	34.3	2.200	39.0	5.500	60.8	9.500	79.3
0.800	33.5	2.400	40.7	6.000	63.4		
1.000	31.5	2.600	42.3	6.500	65.9		

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Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	78.696	0.196	24.0	177.9	O K
30 min Summer	78.745	0.245	31.0	224.6	O K
60 min Summer	78.790	0.290	32.6	268.0	O K
120 min Summer	78.826	0.326	33.2	303.0	O K
180 min Summer	78.842	0.342	33.4	319.1	O K
240 min Summer	78.849	0.349	33.5	326.3	O K
360 min Summer	78.849	0.349	33.5	325.9	O K
480 min Summer	78.839	0.339	33.4	315.8	O K
600 min Summer	78.825	0.325	33.2	302.8	O K
720 min Summer	78.811	0.311	33.0	289.0	O K
960 min Summer	78.785	0.285	32.4	262.6	O K
1440 min Summer	78.745	0.245	30.9	224.3	O K
2160 min Summer	78.711	0.211	26.3	192.1	O K
2880 min Summer	78.690	0.190	23.0	171.8	O K
4320 min Summer	78.663	0.163	18.3	146.8	O K
5760 min Summer	78.647	0.147	15.5	131.7	O K
7200 min Summer	78.635	0.135	13.5	121.1	O K
8640 min Summer	78.626	0.126	12.0	113.0	O K
10080 min Summer	78.619	0.119	10.9	106.4	O K
15 min Winter	78.718	0.218	27.4	198.8	O K
30 min Winter	78.774	0.274	32.2	252.4	O K
60 min Winter	78.827	0.327	33.2	304.2	O K
120 min Winter	78.863	0.363	33.7	340.8	O K
180 min Winter	78.877	0.377	33.8	354.4	O K
240 min Winter	78.880	0.380	33.9	357.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	27.344	0.0	183.4	24
30 min Summer	18.129	0.0	246.1	35
60 min Summer	11.729	0.0	326.4	60
120 min Summer	7.460	0.0	416.4	94
180 min Summer	5.702	0.0	478.1	130
240 min Summer	4.708	0.0	526.8	164
360 min Summer	3.579	0.0	601.2	232
480 min Summer	2.933	0.0	657.3	298
600 min Summer	2.514	0.0	704.2	364
720 min Summer	2.216	0.0	745.1	426
960 min Summer	1.817	0.0	814.5	548
1440 min Summer	1.374	0.0	923.1	784
2160 min Summer	1.039	0.0	1053.4	1148
2880 min Summer	0.852	0.0	1150.6	1504
4320 min Summer	0.644	0.0	1302.2	2216
5760 min Summer	0.529	0.0	1431.6	2944
7200 min Summer	0.454	0.0	1535.5	3680
8640 min Summer	0.400	0.0	1624.6	4408
10080 min Summer	0.359	0.0	1697.8	5144
15 min Winter	27.344	0.0	206.5	24
30 min Winter	18.129	0.0	276.7	36
60 min Winter	11.729	0.0	366.1	62
120 min Winter	7.460	0.0	466.9	102
180 min Winter	5.702	0.0	536.0	140
240 min Winter	4.708	0.0	590.6	178

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Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
360 min Winter	78.868	0.368	33.8	345.6	O K
480 min Winter	78.847	0.347	33.5	324.0	O K
600 min Winter	78.823	0.323	33.2	300.5	O K
720 min Winter	78.800	0.300	32.8	277.8	O K
960 min Winter	78.761	0.261	31.9	239.5	O K
1440 min Winter	78.718	0.218	27.3	198.4	O K
2160 min Winter	78.683	0.183	21.8	165.8	O K
2880 min Winter	78.663	0.163	18.2	146.7	O K
4320 min Winter	78.639	0.139	14.1	124.1	O K
5760 min Winter	78.624	0.124	11.6	110.7	O K
7200 min Winter	78.614	0.114	10.0	101.4	O K
8640 min Winter	78.606	0.106	8.9	94.5	O K
10080 min Winter	78.600	0.100	8.0	88.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
360 min Winter	3.579	0.0	673.9	250
480 min Winter	2.933	0.0	736.8	320
600 min Winter	2.514	0.0	789.4	386
720 min Winter	2.216	0.0	835.2	448
960 min Winter	1.817	0.0	913.0	566
1440 min Winter	1.374	0.0	1034.9	802
2160 min Winter	1.039	0.0	1180.2	1160
2880 min Winter	0.852	0.0	1289.3	1528
4320 min Winter	0.644	0.0	1459.7	2248
5760 min Winter	0.529	0.0	1603.6	2992
7200 min Winter	0.454	0.0	1720.2	3680
8640 min Winter	0.400	0.0	1820.2	4408
10080 min Winter	0.359	0.0	1902.9	5136

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Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	78.962	0.462	34.4	441.8	O K
30 min Summer	79.091	0.591	34.4	579.3	O K
60 min Summer	79.211	0.711	34.4	713.9	O K
120 min Summer	79.306	0.806	34.4	824.4	O K
180 min Summer	79.337	0.837	34.4	861.7	O K
240 min Summer	79.345	0.845	34.4	870.6	O K
360 min Summer	79.342	0.842	34.4	866.9	O K
480 min Summer	79.329	0.829	34.4	851.8	O K
600 min Summer	79.310	0.810	34.4	829.3	O K
720 min Summer	79.288	0.788	34.4	802.9	O K
960 min Summer	79.238	0.738	34.4	745.6	O K
1440 min Summer	79.137	0.637	34.4	630.8	O K
2160 min Summer	79.001	0.501	34.4	483.2	O K
2880 min Summer	78.897	0.397	34.0	374.2	O K
4320 min Summer	78.770	0.270	32.1	248.9	O K
5760 min Summer	78.724	0.224	28.1	204.1	O K
7200 min Summer	78.699	0.199	24.4	180.1	O K
8640 min Summer	78.681	0.181	21.5	163.9	O K
10080 min Summer	78.668	0.168	19.2	151.8	O K
15 min Winter	79.015	0.515	34.4	497.6	O K
30 min Winter	79.158	0.658	34.4	653.8	O K
60 min Winter	79.292	0.792	34.4	808.4	O K
120 min Winter	79.403	0.903	34.4	941.1	O K
180 min Winter	79.444	0.944	34.4	992.4	O K
240 min Winter	79.457	0.957	34.4	1007.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	66.918	0.0	461.9	25
30 min Summer	44.560	0.0	618.0	39
60 min Summer	28.447	0.0	798.3	66
120 min Summer	17.644	0.0	991.3	124
180 min Summer	13.199	0.0	1112.8	180
240 min Summer	10.691	0.0	1202.2	212
360 min Summer	7.910	0.0	1334.6	276
480 min Summer	6.387	0.0	1437.1	342
600 min Summer	5.407	0.0	1520.9	410
720 min Summer	4.717	0.0	1592.3	478
960 min Summer	3.801	0.0	1710.6	614
1440 min Summer	2.800	0.0	1889.2	874
2160 min Summer	2.059	0.0	2090.6	1240
2880 min Summer	1.654	0.0	2239.1	1592
4320 min Summer	1.214	0.0	2461.1	2256
5760 min Summer	0.974	0.0	2639.0	2944
7200 min Summer	0.820	0.0	2778.4	3680
8640 min Summer	0.713	0.0	2897.1	4408
10080 min Summer	0.634	0.0	3000.5	5144
15 min Winter	66.918	0.0	518.4	25
30 min Winter	44.560	0.0	693.2	39
60 min Winter	28.447	0.0	894.6	66
120 min Winter	17.644	0.0	1110.8	122
180 min Winter	13.199	0.0	1246.9	178
240 min Winter	10.691	0.0	1347.0	234

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Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
360 min Winter	79.444	0.944	34.4	992.4	O K
480 min Winter	79.425	0.925	34.4	968.2	O K
600 min Winter	79.396	0.896	34.4	932.6	O K
720 min Winter	79.361	0.861	34.4	890.5	O K
960 min Winter	79.284	0.784	34.4	798.5	O K
1440 min Winter	79.125	0.625	34.4	616.9	O K
2160 min Winter	78.924	0.424	34.2	402.4	O K
2880 min Winter	78.794	0.294	32.6	272.1	O K
4320 min Winter	78.712	0.212	26.4	192.4	O K
5760 min Winter	78.681	0.181	21.4	163.5	O K
7200 min Winter	78.662	0.162	18.2	145.8	O K
8640 min Winter	78.649	0.149	15.8	133.4	O K
10080 min Winter	78.639	0.139	14.1	124.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
360 min Winter	7.910	0.0	1495.3	298
480 min Winter	6.387	0.0	1610.1	372
600 min Winter	5.407	0.0	1704.0	448
720 min Winter	4.717	0.0	1784.0	522
960 min Winter	3.801	0.0	1916.5	666
1440 min Winter	2.800	0.0	2116.9	934
2160 min Winter	2.059	0.0	2342.0	1284
2880 min Winter	1.654	0.0	2508.4	1596
4320 min Winter	1.214	0.0	2757.7	2252
5760 min Winter	0.974	0.0	2956.0	2952
7200 min Winter	0.820	0.0	3112.3	3672
8640 min Winter	0.713	0.0	3245.4	4408
10080 min Winter	0.634	0.0	3362.1	5136

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	79.089	0.589	34.4	577.1	O K
30 min Summer	79.258	0.758	34.4	768.1	O K
60 min Summer	79.419	0.919	34.4	961.0	O K
120 min Summer	79.555	1.055	34.4	1132.3	O K
180 min Summer	79.611	1.111	34.4	1205.2	O K
240 min Summer	79.633	1.133	34.4	1233.6	O K
360 min Summer	79.629	1.129	34.4	1228.4	O K
480 min Summer	79.612	1.112	34.4	1205.9	O K
600 min Summer	79.589	1.089	34.4	1176.9	O K
720 min Summer	79.565	1.065	34.4	1144.9	O K
960 min Summer	79.511	1.011	34.4	1075.9	O K
1440 min Summer	79.399	0.899	34.4	936.5	O K
2160 min Summer	79.238	0.738	34.4	744.6	O K
2880 min Summer	79.095	0.595	34.4	583.8	O K
4320 min Summer	78.890	0.390	34.0	367.3	O K
5760 min Summer	78.778	0.278	32.3	256.3	O K
7200 min Summer	78.733	0.233	29.3	212.8	O K
8640 min Summer	78.708	0.208	25.9	189.5	O K
10080 min Summer	78.691	0.191	23.2	173.1	O K
15 min Winter	79.154	0.654	34.4	649.8	O K
30 min Winter	79.341	0.841	34.4	866.1	O K
60 min Winter	79.520	1.020	34.4	1087.0	O K
120 min Winter	79.676	1.176	34.4	1291.7	O K
180 min Winter	79.742	1.242	34.4	1380.6	O K
240 min Winter	79.769	1.269	34.4	1418.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	86.454	0.0	599.3	25
30 min Summer	58.142	0.0	808.9	39
60 min Summer	37.356	0.0	1049.7	68
120 min Summer	23.203	0.0	1305.0	126
180 min Summer	17.315	0.0	1461.2	184
240 min Summer	13.973	0.0	1572.5	242
360 min Summer	10.267	0.0	1733.4	340
480 min Summer	8.252	0.0	1857.9	392
600 min Summer	6.960	0.0	1958.9	452
720 min Summer	6.053	0.0	2044.3	514
960 min Summer	4.852	0.0	2184.6	646
1440 min Summer	3.545	0.0	2393.8	912
2160 min Summer	2.585	0.0	2625.5	1300
2880 min Summer	2.063	0.0	2793.7	1652
4320 min Summer	1.499	0.0	3041.0	2340
5760 min Summer	1.194	0.0	3234.9	3000
7200 min Summer	0.999	0.0	3385.2	3680
8640 min Summer	0.864	0.0	3512.4	4408
10080 min Summer	0.765	0.0	3624.2	5144
15 min Winter	86.454	0.0	672.2	25
30 min Winter	58.142	0.0	906.9	39
60 min Winter	37.356	0.0	1176.2	68
120 min Winter	23.203	0.0	1462.1	124
180 min Winter	17.315	0.0	1637.0	182
240 min Winter	13.973	0.0	1761.6	238

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
360 min Winter	79.774	1.274	34.4	1425.6	O K
480 min Winter	79.754	1.254	34.4	1397.9	O K
600 min Winter	79.727	1.227	34.4	1360.0	O K
720 min Winter	79.697	1.197	34.4	1320.2	O K
960 min Winter	79.623	1.123	34.4	1220.6	O K
1440 min Winter	79.445	0.945	34.4	993.2	O K
2160 min Winter	79.193	0.693	34.4	693.9	O K
2880 min Winter	78.986	0.486	34.4	466.5	O K
4320 min Winter	78.759	0.259	31.8	237.8	O K
5760 min Winter	78.710	0.210	26.2	190.9	O K
7200 min Winter	78.685	0.185	22.1	167.0	O K
8640 min Winter	78.668	0.168	19.1	151.2	O K
10080 min Winter	78.655	0.155	16.9	139.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
360 min Winter	10.267	0.0	1941.8	348
480 min Winter	8.252	0.0	2081.2	450
600 min Winter	6.960	0.0	2194.3	486
720 min Winter	6.053	0.0	2290.0	562
960 min Winter	4.852	0.0	2447.1	716
1440 min Winter	3.545	0.0	2681.6	992
2160 min Winter	2.585	0.0	2941.1	1372
2880 min Winter	2.063	0.0	3129.5	1708
4320 min Winter	1.499	0.0	3407.2	2296
5760 min Winter	1.194	0.0	3623.4	2968
7200 min Winter	0.999	0.0	3791.9	3680
8640 min Winter	0.864	0.0	3934.6	4408
10080 min Winter	0.765	0.0	4060.7	5144

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	79.301	0.801	34.4	819.1	O K
30 min Summer	79.526	1.026	34.4	1094.8	O K
60 min Summer	79.742	1.242	34.4	1381.5	O K
120 min Summer	79.929	1.429	34.4	1645.1	O K
180 min Summer	80.011	1.511	34.4	1766.5	O K
240 min Summer	80.050	1.550	34.4	1824.5	O K
360 min Summer	80.070	1.570	34.4	1855.4	O K
480 min Summer	80.061	1.561	34.4	1842.2	O K
600 min Summer	80.047	1.547	34.4	1820.1	O K
720 min Summer	80.029	1.529	34.4	1793.4	O K
960 min Summer	79.989	1.489	34.4	1734.0	O K
1440 min Summer	79.903	1.403	34.4	1607.5	O K
2160 min Summer	79.766	1.266	34.4	1414.4	O K
2880 min Summer	79.611	1.111	34.4	1204.7	O K
4320 min Summer	79.300	0.800	34.4	817.7	O K
5760 min Summer	79.066	0.566	34.4	552.3	O K
7200 min Summer	78.906	0.406	34.1	384.4	O K
8640 min Summer	78.808	0.308	32.9	285.9	O K
10080 min Summer	78.754	0.254	31.7	233.2	O K
15 min Winter	79.387	0.887	34.4	921.3	O K
30 min Winter	79.633	1.133	34.4	1233.6	O K
60 min Winter	79.867	1.367	34.4	1556.5	O K
120 min Winter	80.074	1.574	34.4	1861.2	O K
180 min Winter	80.168	1.668	34.4	2007.3	O K
240 min Winter	80.216	1.716	34.7	2082.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	121.036	0.0	842.3	26
30 min Summer	81.399	0.0	1135.3	40
60 min Summer	52.299	0.0	1471.3	70
120 min Summer	32.485	0.0	1828.6	128
180 min Summer	24.241	0.0	2047.2	186
240 min Summer	19.562	0.0	2202.9	244
360 min Summer	14.373	0.0	2428.0	362
480 min Summer	11.553	0.0	2602.3	442
600 min Summer	9.745	0.0	2743.5	500
720 min Summer	8.475	0.0	2862.9	564
960 min Summer	6.792	0.0	3058.8	694
1440 min Summer	4.963	0.0	3350.0	972
2160 min Summer	3.619	0.0	3676.9	1388
2880 min Summer	2.889	0.0	3912.9	1792
4320 min Summer	2.099	0.0	4260.5	2508
5760 min Summer	1.671	0.0	4529.8	3176
7200 min Summer	1.399	0.0	4740.5	3824
8640 min Summer	1.210	0.0	4919.1	4496
10080 min Summer	1.071	0.0	5076.8	5144
15 min Winter	121.036	0.0	944.3	26
30 min Winter	81.399	0.0	1272.0	40
60 min Winter	52.299	0.0	1648.3	68
120 min Winter	32.485	0.0	2048.5	126
180 min Winter	24.241	0.0	2293.2	182
240 min Winter	19.562	0.0	2467.6	240

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
360 min Winter	80.249	1.749	35.0	2136.6	O K
480 min Winter	80.250	1.750	35.0	2137.3	O K
600 min Winter	80.232	1.732	34.8	2107.7	O K
720 min Winter	80.207	1.707	34.6	2068.3	O K
960 min Winter	80.159	1.659	34.4	1992.5	O K
1440 min Winter	80.040	1.540	34.4	1809.8	O K
2160 min Winter	79.840	1.340	34.4	1517.7	O K
2880 min Winter	79.601	1.101	34.4	1191.6	O K
4320 min Winter	79.130	0.630	34.4	623.1	O K
5760 min Winter	78.851	0.351	33.6	328.3	O K
7200 min Winter	78.743	0.243	30.7	222.6	O K
8640 min Winter	78.714	0.214	26.7	194.6	O K
10080 min Winter	78.695	0.195	23.8	176.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
360 min Winter	14.373	0.0	2719.7	352
480 min Winter	11.553	0.0	2914.7	462
600 min Winter	9.745	0.0	3072.8	564
720 min Winter	8.475	0.0	3206.5	590
960 min Winter	6.792	0.0	3425.7	740
1440 min Winter	4.963	0.0	3751.1	1050
2160 min Winter	3.619	0.0	4118.4	1500
2880 min Winter	2.889	0.0	4382.9	1936
4320 min Winter	2.099	0.0	4773.1	2596
5760 min Winter	1.671	0.0	5073.6	3176
7200 min Winter	1.399	0.0	5309.8	3688
8640 min Winter	1.210	0.0	5510.1	4416
10080 min Winter	1.071	0.0	5687.6	5144

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Appendix G

Ground Investigation Extracts

OAKLEY FARM, PRIORS ROAD, CHELTENHAM, GL52 5AQ

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EXISTING SITE LAYOUT (based on Aerial Image from Google Maps) SHOWING INVESTIGATION LOCATIONS

Job No.	Drawing No.	Scale:	Date:
4360/2	4360/2/2	NTS	14-11-18

Wilson Associates
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BOREHOLE LOG

Project				BOREHOLE No
Oakley Farm, Priors Road, Cheltenham GL52 5AQ				**WS1**
Job No	Date	Ground Level (c.m, AOD)	Co-Ordinates (c.)	
4360/2	30-07-18	76.00	E 396,804 N 222,517	
Contractor				Sheet
Cook Ground Investigation Limited				1 of 1

SAMPLES & TESTS			STRATA						
Depth	Type No	Test Result	Water	Undrained Shear Strength	Legend	Depth (Thick-ness)	DESCRIPTION	Geology	Instrument/ Backfill
0.10	D					0.18	TOPSOIL: probable firm, dull brown, organic, heavily rooted CLAY		
0.30	D					0.35	MADE GROUND: probable stiff, desiccated, light brown, slightly gravelly CLAY (gravel is brick and glass fragments)		
0.50	D						CLAY: probable initially firm, light brown to light grey, desiccated CLAY		
							0.85 - possible relict shear surface (inclined at 45°)		
1.00		N9							
1.50	D						1.40 - becoming normally hydrated, mottled light grey to light brown CLAY, with occasional shell fragments and pockets of gypsum		
2.00	D						2.00 - becoming stiff		
2.00		N23				(4.10)		CMF	
2.50	D								
3.00		N26					3.00 - becoming dark grey CLAY		
3.50	D						3.65 - weathered fissure observed		
							3.70 - rootlet observed		
4.00		N27				4.45			
							Core Recovery:		
							0.0 - 4.0m 100%		
							All insitu strength testing undertaken using CPT		
							Falling head testing carried out		
							Borehole terminated at 4.45m depth		
							Gas/groundwater monitoring standpipe installed to 4.0m depth; fitted with gas valve and lockable cover		

Boring Progress and Water Observations						Chiselling			Water Added	
Date	Hole Dia. mm	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To
30/07/2018					DRY					

GENERAL REMARKS

Borehole position scanned using Cable Avoidance Tool (CAT); no services detected

CMF = Charmouth Mudstone Formation

All dimensions in metres Scale 1:50	Client Robert Hitchins Limited	Method/ Plant Used Archway Dart 338	Logged By CM

Wilson Associates
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BOREHOLE LOG

Project				BOREHOLE No
Oakley Farm, Priors Road, Cheltenham GL52 5AQ				**WS2**
Job No	Date	Ground Level (c.m, AOD)	Co-Ordinates (c.)	
4360/2	30-07-18	91.00	E 396,896 N 222,409	
Contractor				Sheet
Cook Ground Investigation Limited				1 of 1

SAMPLES & TESTS			STRATA						
Depth	Type No	Test Result	Water	Undrained Shear Strength	Legend	Depth (Thick-ness)	DESCRIPTION	Geology	Instrument/ Backfill
						0.30	TOPSOIL: probable firm to stiff, light brown, organic, desiccated, heavily rooted CLAY		
0.30	D						CLAY: probable firm, light brown to light grey, desiccated CLAY		
0.50	D								
0.70	D						0.75 - possible shear surface (inclined at c45°)		
1.00	D						0.90 - becoming normally hydrated, with frequent pockets of gypsum		
1.00		N12							
							1.50 - weathered fissure		
							1.80 - becoming dark grey, locally mottled light brown		
2.00		N13							
						(4.15)		CMF	
							2.90 - becoming stiff, dark bluish-grey, with frequent fossil fragments		
3.00	D								
3.00		N24							
4.00		N26							
						4.45			
							Core Recovery:		
							0.0 - 4.0m 100%		
							All insitu strength testing undertaken using CPT		
							Borehole terminated at 4.45m depth		
							Gas/groundwater monitoring standpipe installed to 4.0m depth; fitted with gas valve and lockable cover		

Boring Progress and Water Observations					
Date	Hole Dia. mm	Depth	Casing Depth	Casing Dia. mm	Water Dpt
30/07/2018					DRY

Chiselling			Water Added	
From	To	Hours	From	To

GENERAL REMARKS

Borehole position scanned using Cable Avoidance Tool (CAT); no services detected

CMF = Charmouth Mudstone Formation

All dimensions in metres Scale 1:50	Client Robert Hitchins Limited	Method/ Plant Used Archway Dart 338	Logged By CM

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BOREHOLE LOG

Project				BOREHOLE No
Oakley Farm, Priors Road, Cheltenham GL52 5AQ				**WS3**
Job No	Date	Ground Level (c.m, AOD)	Co-Ordinates (c.)	
4360/2	30-07-18	82.00	E 396,944 N 222,512	
Contractor				Sheet
Cook Ground Investigation Limited				1 of 1

SAMPLES & TESTS			STRATA							
Depth	Type No	Test Result	Water	Undrained Shear Strength	Legend	Depth (Thick-ness)	DESCRIPTION	Geology	Instrument/ Backfill
						0.20	TOPSOIL: probable firm to stiff, dark brown, organic, heavily rooted CLAY		
							CLAY: probable initially firm, light brown, desiccated CLAY with rare roots		
							0.65 - possible shear surface; rare gravel of rounded medium limestone		
1.00		N13					0.90 - becoming normally hydrated, dark grey to light brown CLAY, with frequent pockets of gypsum		
2.00		N18				(4.25)		CMF	
							2.60 - no more live rootlets observed		
3.00		N23					3.00 - becoming stiff		
							3.50 - frequent fossil fragments		
4.00		N28				4.45			
							Core Recovery:		
							0.0 - 4.0m 100%		
							All insitu strength testing undertaken using CPT		
							Borehole terminated at 4.45m depth		
							Gas/groundwater monitoring standpipe installed to 4.0m depth; fitted with gas valve and lockable cover		

Boring Progress and Water Observations					
Date	Hole Dia. mm	Depth	Casing Depth	Casing Dia. mm	Water Dpt
30/07/2018					DRY

Chiselling			Water Added	
From	To	Hours	From	To

GENERAL REMARKS

Borehole position scanned using Cable Avoidance Tool (CAT); no services detected

CMF = Charmouth Mudstone Formation

All dimensions in metres Scale 1:50	Client Robert Hitchins Limited	Method/ Plant Used Archway Dart 338	Logged By CM

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BOREHOLE LOG

Project				BOREHOLE No
Oakley Farm, Priors Road, Cheltenham GL52 5AQ				**WS4**
Job No	Date	Ground Level (c.m, AOD)	Co-Ordinates (c.)	
4360/2	30-07-18	84.00	E 397,042 N 222,516	
Contractor				Sheet
Cook Ground Investigation Limited				1 of 1

SAMPLES & TESTS			STRATA						
Depth	Type No	Test Result	Water	Undrained Shear Strength	Legend	Depth (Thick-ness)	DESCRIPTION	Geology	Instrument/ Backfill
						(0.40) 0.40	MADE GROUND: grass over probable medium dense, sandy GRAVEL (gravel is brick and concrete)		
1.00		N11					CLAY: probable initially firm, light brown CLAY		
							1.50 - becoming mottled light brown to light grey, with frequent pockets of crystalline gypsum		
2.00		N16							
						(4.05)		CMF	
							2.50 - becoming dark grey CLAY		
3.00		N20					3.00 - becoming stiff		
4.00		N28							
						4.45			
							Core Recovery:		
							0.0 - 4.0m 100%		
							All insitu strength testing undertaken using CPT		
							Borehole terminated at 4.45m depth		
							Gas/groundwater monitoring standpipe installed to 4.0m depth; fitted with gas valve and lockable cover		

Boring Progress and Water Observations					
Date	Hole Dia. mm	Depth	Casing Depth	Casing Dia. mm	Water Dpt
30/07/2018					DRY

Chiselling			Water Added	
From	To	Hours	From	To

GENERAL REMARKS

Borehole position scanned using Cable Avoidance Tool (CAT); no services detected

CMF = Charmouth Mudstone Formation

All dimensions in metres Scale 1:50	Client Robert Hitchins Limited	Method/ Plant Used Archway Dart 338	Logged By CM

WS1 – core 0.0 – 4.0m

WS1 – possible shear plane at 0.85m

WS2 – core 0.0 – 4.0m

WS3 – core 0.0 – 4.0m

WS4 – core 0.0 – 4.0m

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BOREHOLE LOG

Project				BOREHOLE No
Oakley Farm, Priors Road, Cheltenham GL52 5AQ				**WS5**
Job No	Date	Ground Level (c.m, AOD)	Co-Ordinates (c.)	
4360/2	30-07-18	94.00	E 397,178 N 222,509	
Contractor				Sheet
Cook Ground Investigation Limited				1 of 1

SAMPLES & TESTS			STRATA						
Depth	Type No	Test Result	Water	Undrained Shear Strength	Legend	Depth (Thick-ness)	DESCRIPTION	Geology	Instrument/ Backfill
0.10	D					0.15	TOPSOIL: probable firm, light brown, organic, desiccated, heavily rooted CLAY		
0.25	D					0.40	MADE GROUND (reworked): probable firm to stiff, light brown, desiccated CLAY, with fragments of charcoal		
0.50	D						CLAY: probable initially firm, light brown to light grey, desiccated CLAY, with rare rounded limestone and rare roots		
1.00		N10					0.65 - possible shear surface 0.90 - becoming normally hydrated		
							1.50 - no roots observed below this depth		
2.00	D								
2.00		N13				(4.05)		CMF	
							2.80 - becoming dark grey CLAY, with rare pockets of crystalline gypsum		
3.00		N14							
4.00		N29					4.00 - becoming stiff		
						4.45			
							Core Recovery: 0.0 - 4.0m 100% All insitu strength testing undertaken using CPT Borehole terminated at 4.45m depth; backfilled with arising upon completion of testing and sampling		

Boring Progress and Water Observations						Chiselling			Water Added	
Date	Hole Dia. mm	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To
30/07/2018					DRY					

GENERAL REMARKS

Borehole position scanned using Cable Avoidance Tool (CAT); no services detected

CMF = Charmouth Mudstone Formation

All dimensions in metres Scale 1:50	Client Robert Hitchins Limited	Method/ Plant Used Archway Dart 338	Logged By CM

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BOREHOLE LOG

Project				BOREHOLE No
Oakley Farm, Priors Road, Cheltenham GL52 5AQ				**WS6**
Job No	Date	Ground Level (c.m, AOD)	Co-Ordinates (c.)	
4360/2	30-07-18	103.00	E 397,299 N 222,490	
Contractor				Sheet
Cook Ground Investigation Limited				1 of 1

SAMPLES & TESTS			STRATA						
Depth	Type No	Test Result	Water	Undrained Shear Strength	Legend	Depth (Thick-ness)	DESCRIPTION	Geology	Instrument/ Backfill
						(0.40) 0.40	TOPSOIL: probable stiff, light greyish-brown, organic, desiccated, heavily rooted CLAY		
0.50	D						CLAY: probable initially stiff and friable, light brown, desiccated CLAY		
1.00	D						0.90 - becoming firm, normally hydrated, mottled light brown and grey		
1.00		N11							
1.50	D								
2.00	D								
2.00		N16				(4.05)		CMF	
2.50	D								
3.00	D						3.00 - becoming stiff		
3.00		N20							
4.00		N32				4.45			
							Core Recovery:		
							0.0 - 4.0m 100%		
							All insitu strength testing undertaken using CPT		
							Falling head testing carried out		
							Borehole terminated at 4.45m depth		
							Gas/groundwater monitoring standpipe installed to 4.0m depth; fitted with gas valve and lockable cover		

Boring Progress and Water Observations						Chiselling			Water Added	
Date	Hole Dia. mm	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To
30/07/2018					DRY					

GENERAL REMARKS

Borehole position scanned using Cable Avoidance Tool (CAT); no services detected

CMF = Charmouth Mudstone Formation

All dimensions in metres Scale 1:50	Client Robert Hitchins Limited	Method/ Plant Used Archway Dart 338	Logged By CM

Wilson Associates
Consulting Engineering Geologists & Geo-Environmental Engineers

BOREHOLE LOG

Project				BOREHOLE No
Oakley Farm, Priors Road, Cheltenham GL52 5AQ				**WS7**
Job No	Date	Ground Level (c.m, AOD)	Co-Ordinates (c.)	
4360/2	30-07-18	101.00	E 397,140 N 222,423	
Contractor				Sheet
Cook Ground Investigation Limited				1 of 1

SAMPLES & TESTS			STRATA						
Depth	Type No	Test Result	Water	Undrained Shear Strength	Legend	Depth (Thick-ness)	DESCRIPTION	Geology	Instrument/ Backfill
						0.25	TOPSOIL: probable stiff, light brown, organic, desiccated, heavily rooted CLAY		
							CLAY: probable initially firm to stiff, desiccated, light brown to light grey CLAY		
1.00		N8					1.00 - becoming soft to firm, normally hydrated		
						(3.20)		CMF	
2.00		N24					2.00 - becoming stiff		
							2.80 - 10mm band of iron-rich limestone		
3.00		N50							
						3.45			
							Core Recovery:		
							0.0 - 4.0m 100%		
							All insitu strength testing undertaken using CPT		
							Borehole terminated on iron-rich limestone at 3.45m depth; backfilled with arising upon completion of testing and sampling		

Boring Progress and Water Observations					
Date	Hole Dia. mm	Depth	Casing Depth	Casing Dia. mm	Water Dpt
30/07/2018					DRY

Chiselling			Water Added	
From	To	Hours	From	To

GENERAL REMARKS

Borehole position scanned using Cable Avoidance Tool (CAT); no services detected

CMF = Charmouth Mudstone Formation

All dimensions in metres Scale 1:50	Client Robert Hitchins Limited	Method/ Plant Used Archway Dart 338	Logged By CM

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BOREHOLE LOG

Project				BOREHOLE No
Oakley Farm, Priors Road, Cheltenham GL52 5AQ				**WS8**
Job No	Date	Ground Level (c.m, AOD)	Co-Ordinates (c.)	
4360/2	31-07-18	96.00	E 397,016 N 222,419	
Contractor				Sheet
Cook Ground Investigation Limited				1 of 1

SAMPLES & TESTS			STRATA						
Depth	Type No	Test Result	Water	Undrained Shear Strength	Legend	Depth (Thick-ness)	DESCRIPTION	Geology	Instrument/ Backfill
0.10	D					0.30	TOPSOIL: probable firm, light brown, organic, desiccated, heavily rooted CLAY		
0.30	D						CLAY: probable initially stiff, desiccated, light brown to light grey CLAY, with occasional gravel of subangular limestone		
0.50	D								
0.80-0.90	D								
1.00		N11					1.00 - becoming firm		
1.30	D						1.30 - appearing normally hydrated		
2.00	D								
2.00		N16							
2.30	D					(4.15)		CMF	
							2.50 - weathered fissure observed; becoming stiff, dark grey, with relict mudstone structure evident		
3.00		N26							
3.30	D								
4.00		N27							
						4.45			
							Core Recovery:		
							0.0 - 4.0m 100%		
							All insitu strength testing undertaken using CPT		
							Borehole terminated at 4.45m depth		
							Gas/groundwater monitoring standpipe installed to 4.0m depth; fitted with gas valve and lockable cover		

Boring Progress and Water Observations					
Date	Hole Dia. mm	Depth	Casing Depth	Casing Dia. mm	Water Dpt
31/07/2018					DRY

Chiselling			Water Added	
From	To	Hours	From	To

GENERAL REMARKS

Borehole position scanned using Cable Avoidance Tool (CAT); no services detected

CMF = Charmouth Mudstone Formation

All dimensions in metres Scale 1:50	Client Robert Hitchins Limited	Method/ Plant Used Archway Dart 338	Logged By CM

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BOREHOLE LOG

Project				BOREHOLE No
Oakley Farm, Priors Road, Cheltenham GL52 5AQ				**WS9**
Job No	Date	Ground Level (c.m, AOD)	Co-Ordinates (c.)	
4360/2	31-07-18	110.00	E 397,239 N 222,402	
Contractor				Sheet
Cook Ground Investigation Limited				1 of 1

SAMPLES & TESTS			STRATA						
Depth	Type No	Test Result	Water	Undrained Shear Strength	Legend	Depth (Thick-ness)	DESCRIPTION	Geology	Instrument/ Backfill
0.20	D					0.30	TOPSOIL: probable firm to stiff, dull brown, organic, desiccated, heavily rooted CLAY		
0.50	D						CLAY: probable initially stiff, light brown to light grey, desiccated CLAY		
0.70	D								
1.00		N12					1.10 - becoming firm, normally hydrated, light brown to light grey CLAY, with rare gravel of subrounded limestone		
1.30	D								
1.70	D					(3.14)		CMF	
2.00		N24					2.00 - becoming stiff		
2.30	D								
2.70	D								
3.00		N50/ 295 mm					2.90 - grading to dark grey CLAY, with relict mudstone structure evident		
						3.44			
							Core Recovery:		
							0.0 - 3.0m 100%		
							All insitu strength testing undertaken using CPT		
							Falling head testing carried out		
							Borehole terminated on refusal at 3.44m depth; backfilled with arisings upon completion of testing and sampling		

Boring Progress and Water Observations						Chiselling			Water Added	
Date	Hole Dia. mm	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To
31/07/2018					DRY					

GENERAL REMARKS

Borehole position scanned using Cable Avoidance Tool (CAT); no services detected

CMF = Charmouth Mudstone Formation

All dimensions in metres Scale 1:50	Client Robert Hitchins Limited	Method/ Plant Used Archway Dart 338	Logged By CM

Wilson Associates
Consulting Engineering Geologists & Geo-Environmental Engineers

BOREHOLE LOG

Project				BOREHOLE No
Oakley Farm, Priors Road, Cheltenham GL52 5AQ				**WS10**
Job No	Date	Ground Level (c.m, AOD)	Co-Ordinates (c.)	
4360/2	30-07-18	118.00	E 397,090 N 222,249	
Contractor				Sheet
Cook Ground Investigation Limited				1 of 1

SAMPLES & TESTS			STRATA						
Depth	Type No	Test Result	Water	Undrained Shear Strength	Legend	Depth (Thick-ness)	DESCRIPTION	Geology	Instrument/ Backfill
0.05	D					0.20	TURF over TOPSOIL: probable firm, dark brown, organic, slightly sandy CLAY, with frequent grass rootlets		
0.20	D					0.50	CLAY: probable firm to stiff, brown mottled orange and grey, silty, locally slightly sandy CLAY; occasional grass rootlets, slightly desiccated		
0.50	D					(0.50)		CMF	
						1.00	CLAY: probable firm, orangish-brown and grey, silty locally slightly sandy CLAY		
1.00		N23					CLAY: stiff,grey, thinly laminated, mottled orange silty CLAY		
1.50	D					(1.40)	1.00 - slightly gravelly (gravel is angular to subangular, medium and coarse, extremely weak mudstone) 1.20 - becoming thinly laminated - bands of grey, black, orange and brown, very silty CLAY	CMF	
2.00		N46					1.65 - gravel becoming very weak 1.85 - very thinly bedded, grey, silty CLAY, weathered orangish-brown (iron) on bedded planes		
						2.40	2.00 - becoming very stiff		
						(1.02)	CLAY/MUDSTONE: probable very stiff, dark grey and mottled reddish-brown, silty CLAY/extremely weak MUDSTONE	CMF	
3.00		N50/ 267 mm				3.42			
							Core Recovery: 0.0 - 3.0m 100% All insitu strength testing undertaken using SPT Borehole terminated at 3.42m depth Gas/groundwater monitoring standpipe installed to 3.0m depth; fitted with gas valve and lockable cover		

Boring Progress and Water Observations					
Date	Hole Dia. mm	Depth	Casing Depth	Casing Dia. mm	Water Dpt
30/07/2018					DRY

Chiselling			Water Added	
From	To	Hours	From	To

GENERAL REMARKS

Borehole position scanned using Cable Avoidance Tool (CAT); no services detected

CMF = Charmouth Mudstone Formation

All dimensions in metres Scale 1:50	Client Robert Hitchins Limited	Method/ Plant Used Window Sampling / Terrier 2002 (T06)	Logged By AJ

Wilson Associates
Consulting Engineering Geologists & Geo-Environmental Engineers

BOREHOLE LOG

Project				BOREHOLE No
Oakley Farm, Priors Road, Cheltenham GL52 5AQ				**WS11**
Job No	Date	Ground Level (c.m, AOD)	Co-Ordinates (c.)	
4360/2	30-07-18	119.00	E 397,306 N 222,304	
Contractor				Sheet
Cook Ground Investigation Limited				1 of 1

SAMPLES & TESTS			STRATA						
Depth	Type No	Test Result	Water	Undrained Shear Strength	Legend	Depth (Thick-ness)	DESCRIPTION	Geology	Instrument/ Backfill
0.00-0.30	D					0.20	TURF over TOPSOIL: probable firm, brown, organic, sandy, slightly gravelly, desiccated CLAY (gravel is subangular to subrounded, fine to coarse mudstone, chalk, occasional flint, very rare clinker and brick); frequent grass rootlets		
0.10	D					0.55			
0.50	D						CLAY: probable firm, greyish-brown, very sandy, slightly gravelly CLAY (gravel is angular to subrounded, fine to coarse mudstone); occasional roots and rootlets		
0.75	D								
1.00		N11					CLAY: firm, grey mottled orange and brown, silty, slightly sandy, slightly gravelly CLAY (gravel is angular to subrounded, fine to medium mudstone		
						(2.15)	1.35 - becoming grey	CMF	
1.75	D								
2.00		N25					2.00 - becoming stiff		
						2.70			
						(0.65)	CLAY/MUDSTONE: very stiff, orange and greyish-brown mottled red, thinly laminated, silty, slightly gravelly CLAY/extremely weak MUDSTONE	CMF	
3.00		N36				3.35			
							CLAY: very stiff, grey, silty CLAY		
						(1.06)		CMF	
4.00		N50/ 291 mm				4.41			
							Core Recovery:		
							0.0 - 1.2m hand-dug starter pit 1.2 - 4.0m 100%		
							All insitu strength testing undertaken using SPT		
							Borehole terminated upon refusal at 4.41m depth		
							Gas/groundwater monitoring standpipe installed to 4.0m depth; fitted with gas valve and lockable cover		

Boring Progress and Water Observations					
Date	Hole Dia. mm	Depth	Casing Depth	Casing Dia. mm	Water Dpt
30/07/2018					DRY

Chiselling			Water Added	
From	To	Hours	From	To

GENERAL REMARKS

Borehole position scanned using Cable Avoidance Tool (CAT); no services detected

CMF = Charmouth Mudstone Formation

All dimensions in metres Scale 1:50	Client Robert Hitchins Limited	Method/ Plant Used Window Sampling / Terrier 2002 (T06)	Logged By AJ

Monitoring undertaken 17 August 2018

Atmospheric Pressure (mb) and Trend	Temperature (°C) and Weather	BH No	Concentrations (%)			Flow rates (l/hr)	Standing water level (m, bgl)	Depth and horizon of response zone (m,bgl)
			CH_4	CO_2	O_2			
1013	16 - 17° C Fair	WS1	0.0	1.7	19.3	-0.1/-0.0	3.76	1.0 – 4.0
1010		WS2	0.0	0.6	20.0	-0.0/+0.0	3.46	1.0 – 4.0
		WS3					3.64	1.0 – 4.0
1012		WS4	0.0	5.3	16.6	-0.0/+0.0	3.48	1.0 – 4.0
1010		WS6	0.0	1.5	19.6	+0.0/+0.0	3.38	1.0 – 4.0
		WS8					1.05	1.0 – 4.0
		WS10					1.53	1.0 – 4.0
1008		WS11	0.0	1.4	20.1	+0.0/+0.1	1.65	1.0 – 4.0

Subcontracted to CC Ground Investigations

Gas monitoring carried out using a GA5000 Gas Analyser

Water monitoring carried out using a Geotechnical Instruments Dip Meter

Monitoring undertaken 24 August 2018

Atmospheric Pressure (mb) and Trend	Temperature (°C) and Weather	BH No	Time (secs/ mins)	Concentrations (%)			Flow rates time (secs/mins)	Flow rates (l/hr)	Standing water level (m, bgl)	Depth and horizon of response zone (m,bgl)
				CH_4	CO_2	O_2				
1005	14° C	WS1	15s	0.0	1.6	20.2	15s	0.0	3.76	1.0 – 4.0
	Cloudy /		30s	0.0	1.6	19.9	30s	0.0		
	sunny		45s	0.0	1.6	19.9	45s	0.0		
			1m	0.0	1.6	19.9	1m	0.0		
			2m	0.0	1.6	19.9	2m	0.0		
			3m	0.0	1.6	19.9	3m	-0.1		
			4m	0.0	1.6	19.8	4m	-0.1		
			5m	0.0	1.5	19.8	5m	-0.1		
			Max Peak	0.0	1.6		Max Peak	0.0		
			Steady Values	0.0	1.6		Steady Values	0.0		
1004	14° C	WS2	15s	0.0	0.5	20.4	15s	0.0	3.26	1.0 – 4.0
	Cloudy /		30s	0.0	0.5	20.3	30s	0.0		
	sunny		45s	0.0	0.5	20.3	45s	0.0		
			1m	0.0	0.5	20.3	1m	0.0		
			2m	0.0	0.5	20.3	2m	0.0		
			3m	0.0	0.5	20.3	3m	-0.1		
			4m	0.0	0.5	20.3	4m	0.0		
			5m	0.0	0.5	20.3	5m	-0.1		
			Max Peak	0.0	0.5		Max Peak	0.0		
			Steady Values	0.0	0.5		Steady Values	0.0		
1004	14° C Cloudy / sunny	WS3							3.47	1.0 – 4.0
1004	15° C	WS4	15s	0.0	2.5	19.2	15s	0.0	3.26	1.0 – 4.0
	Light cloud /		30s	0.0	3.6	18.3	30s	-0.1		
	sunny		45s	0.0	4.3	17.9	45s	-0.1		
			1m	0.0	4.7	17.7	1m	-0.1		
			2m	0.0	4.9	17.6	2m	0.0		
			3m	0.0	4.9	17.6	3m	0.0		
			4m	0.0	4.9	17.6	4m	0.0		
			5m	0.0	4.6	17.8	5m	0.0		
			6m	0.0	4.2	18.0	6m			
			7m	0.0	3.8	18.4	7m			
			8m	0.0	3.5	18.6	8m			
			9m	0.0	3.2	18.9	9m			
			10m	0.0	3.0	19.0	10m			
			Max Peak	0.0	4.9		Max Peak	0.0		
			Steady Values	0.0			Steady Values	0.0		

Atmospheric Pressure (mb) and Trend	Temperature (°C) and Weather	BH No	Time (secs/ mins)	Concentrations (%)			Flow rates time (secs/mins)	Flow rates (l/hr)	Standing water level (m, bgl)	Depth and horizon of response zone (m,bgl)
				CH_4	CO_2	O_2				
1002	15° C Cloudy	WS6	15s	0.0	1.5	20.4	15s	0.0	3.13	1.0 – 4.0
			30s	0.0	1.5	20.2	30s	0.0		
			45s	0.0	1.5	20.0	45s	0.0		
			1m	0.0	1.5	20.0	1m	0.0		
			2m	0.0	1.5	20.0	2m	0.0		
			3m	0.0	1.5	20.0	3m	0.0		
			4m	0.0	1.5	20.0	4m	0.0		
			5m	0.0	1.5	20.0	5m	0.0		
			Max Peak	0.0	1.5		Max Peak	0.0		
			Steady Values	0.0	1.5		Steady Values	0.0		
	15° C Cloudy	WS8							1.02	1.0 – 4.0
	15° C Cloudy	WS10							1.48	1.0 – 3.0
1002	15° C Cloudy	WS11	15s	0.0	1.3	20.5	15s	0.0	1.68	1.0 – 4.0
			30s	0.0	1.3	20.1	30s	0.0		
			45s	0.0	1.3	20.1	45s	0.0		
			1m	0.0	1.3	20.1	1m	0.0		
			2m	0.0	1.3	20.0	2m	0.0		
			3m	0.0	1.3	20.0	3m	0.0		
			4m	0.0	1.3	20.0	4m	0.0		
			5m	0.0	1.3	20.0	5m	0.0		
			Max Peak	0.0	1.3		Max Peak	0.0		
			Steady Values	0.0	1.3		Steady Values	0.0		

Monitoring undertaken by Wilson Associates Consulting Limited

Gas monitoring carried out using a GA5000 Gas Analyser

Water monitoring carried out using a Geotechnical Instruments Dip Meter

Monitoring undertaken 18 September 2018

Atmospheric Pressure (mb) and Trend	Temperature (°C) and Weather	BH No	Concentrations (%)			Flow rates (min / max) (l/hr)	Standing water level (m, bgl)	Depth and horizon of response zone (m,bgl)
			CH_4	CO_2	O_2			
1000	16 - 17° C Cloudy with gusts of wind	WS1	0.0	0.9	20.3	+0.1/+0.2	3.52	1.0 – 4.0
999		WS2	0.0	0.3	20.6	+0.0/+0.0	2.61	1.0 – 4.0
		WS3					3.01	1.0 – 4.0
999		WS4	0.0	3.8	18.5	+0.0/+0.1	2.62	1.0 – 4.0
998		WS6	0.0	1.1	20.2	+0.0/+0.1	2.81	1.0 – 4.0
		WS8					1.12	1.0 – 4.0
		WS10					1.53	1.0 – 3.0
996		WS11	0.0	1.0	20.3	+0.0/+0.1	1.68	1.0 – 4.0

Subcontracted to CC Ground Investigations

Gas monitoring carried out using a GA5000 Gas Analyser

Water monitoring carried out using a Geotechnical Instruments Dip Meter

Appendix H

Micro-Drainage Calculations

Developed Run-off Volume.

Ciria C697 (Box 4.11)

Developed Run-off Volume =10.RD.A[((PIMP/100)α0.8) + ((1-(PIMP/100))βSPR)]

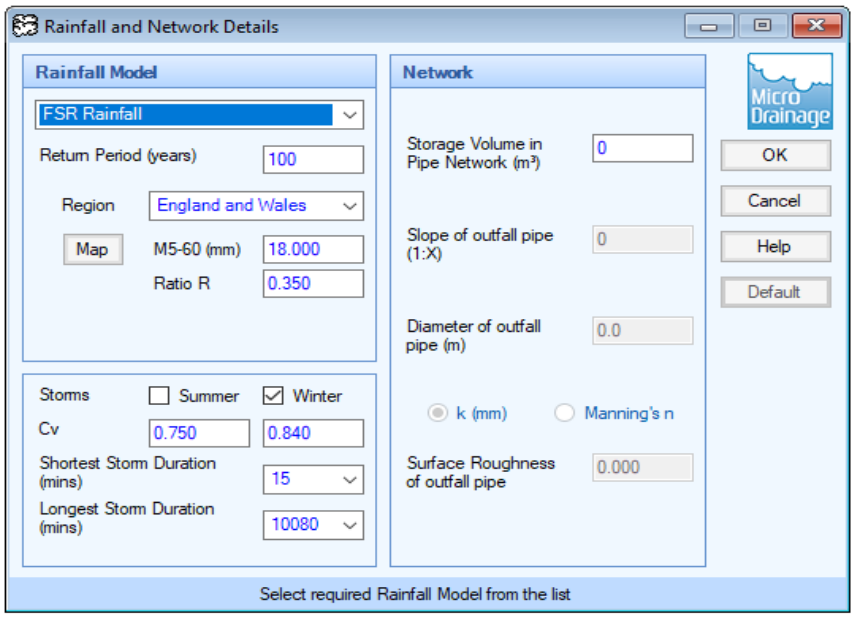
RD = Rainfall depth for 100 year 6 hour event (mm).
PIMP = Percentage impermeable area.
A = Total Catchment Area (ha)
SPR = Standard percentage run-off for soil type (as fraction)
α = Proportion of impermeable draining to system at 80% (0.8) run-off (roofs, parking, roads, etc).
Can be increased to 100 % for more conservative assessment (will depend on materials, drainage...).
β = Proportion of pervious areas draining to system, 0-1.0 (gardens, open space, etc).

Total Area	14.76	Ha
Impereable Area	3.767	Ha
PIMP	26%	
SPR (Soil Type 4)	0.45	
α(100% run-off from impermeable surfaces)	1	
β (100% run-off from gardens to drainage system)	1	

	mm/hrs	mm
RD 100 20% year 6 hour rainfall (6 hours from Micro Drainage)	0	0
RD 100 40% year 6 hour rainfall (6 hours from Micro Drainage)	14.373	86.238

	Total Vol m^3
Development runoff Volume 100 20% year 6hr	0
Development runoff Volume 100 40% year 6hr	6886

Extras From Micro Drainage



Storm Event	Rain (mm/hr)
15 min Winter	83.89
30 min Winter	56.43
60 min Winter	36.29
120 min Winter	22.58
180 min Winter	16.88
240 min Winter	13.64
360 min Winter	10.02
480 min Winter	8.06
600 min Winter	6.80

Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	17.150	0.000	0.0	0.0	O K
30 min Winter	17.150	0.000	0.0	0.0	O K
60 min Winter	17.150	0.000	0.0	0.0	O K
120 min Winter	17.150	0.000	0.0	0.0	O K
180 min Winter	17.150	0.000	0.0	0.0	O K
240 min Winter	17.150	0.000	0.0	0.0	O K
360 min Winter	17.150	0.000	0.0	0.0	O K
480 min Winter	17.150	0.000	0.0	0.0	O K
600 min Winter	17.150	0.000	0.0	0.0	O K
720 min Winter	17.150	0.000	0.0	0.0	O K
960 min Winter	17.150	0.000	0.0	0.0	O K
1440 min Winter	17.150	0.000	0.0	0.0	O K
2160 min Winter	17.150	0.000	0.0	0.0	O K
2880 min Winter	17.150	0.000	0.0	0.0	O K
4320 min Winter	17.150	0.000	0.0	0.0	O K
5760 min Winter	17.150	0.000	0.0	0.0	O K
7200 min Winter	17.150	0.000	0.0	0.0	O K
8640 min Winter	17.150	0.000	0.0	0.0	O K
10080 min Winter	17.150	0.000	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Winter	83.892	0.0	0.0	0
30 min Winter	56.436	0.0	0.0	0
60 min Winter	36.294	0.0	0.0	0
120 min Winter	22.586	0.0	0.0	0
180 min Winter	16.884	0.0	0.0	0
240 min Winter	13.646	0.0	0.0	0
360 min Winter	10.027	0.0	0.0	0
480 min Winter	8.062	0.0	0.0	0
600 min Winter	6.801	0.0	0.0	0
720 min Winter	5.916	0.0	0.0	0
960 min Winter	4.743	0.0	0.0	0
1440 min Winter	3.467	0.0	0.0	0
2160 min Winter	2.529	0.0	0.0	0
2880 min Winter	2.020	0.0	0.0	0
4320 min Winter	1.468	0.0	0.0	0
5760 min Winter	1.169	0.0	0.0	0
7200 min Winter	0.979	0.0	0.0	0
8640 min Winter	0.847	0.0	0.0	0
10080 min Winter	0.749	0.0	0.0	0

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	No	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.000

Time (mins) From:	To:	Area (ha)
0	4	0.000

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Appendix I

Drawing:

476-002 – Catchment Areas

LEGEND:

TOTAL CATCHMENT AREA = 14.76ha

OPEN SPACE AREA = 7.91ha

DEVELOPMENT AREA = 6.85ha

SURFACE WATER RUN-OFF FLOW DIRECTION

FLOOD FLOW NORTH WEST TO WYMAN'S BROOK

OPEN SPACE & POND AREA 0.4722ha

TOTAL OPEN SPACE AREA 7.927ha

DEVELOPMENT AREA 6.83ha

GROSS CATCHMENT AREA 14.76ha

OPEN SPACE AREA 1.365ha

LEVELS EAST OF SITE FROM LIDAR DATA

OPEN SPACE AREA 2.93ha

FLOOD FLOW FROM RESERVOIR FAILURE (LOW RISK)

OPEN SPACE AREA 1.83ha

LEVELS EAST OF SITE FROM LIDAR DATA

RESERVOIR

FLOOD FLOW FROM SOUTH TO HARP HILL

LEVELS SOUTH OF HARP HILL FROM LIDAR DATA

FLOOD FLOW FROM SOUTH TO HARP HILL

APPROX. SURFACE WATER RUN-OFF CATCHMENT TO HARP HILL 8.6ha

FLOOD FLOW FROM SOUTH TO HARP HILL

LEVELS SOUTH OF HARP HILL FROM LIDAR DATA

Revisions

Project: Oakley Farm, Battledown Cheltenham

Client: Robert Hitchins — The Complete Development Solution

Drawing: Catchment Areas

Scale: 1:1,000 @ A1 Date: 13/04/2019 Drawn by: P.A.

Drawing No: 476-002 Rev: -

PHOENIX DESIGN Partnership Ltd.

Unit 9, Westway Garage, Marksbury, Bath. BA2 9HN tel. 01761 476650

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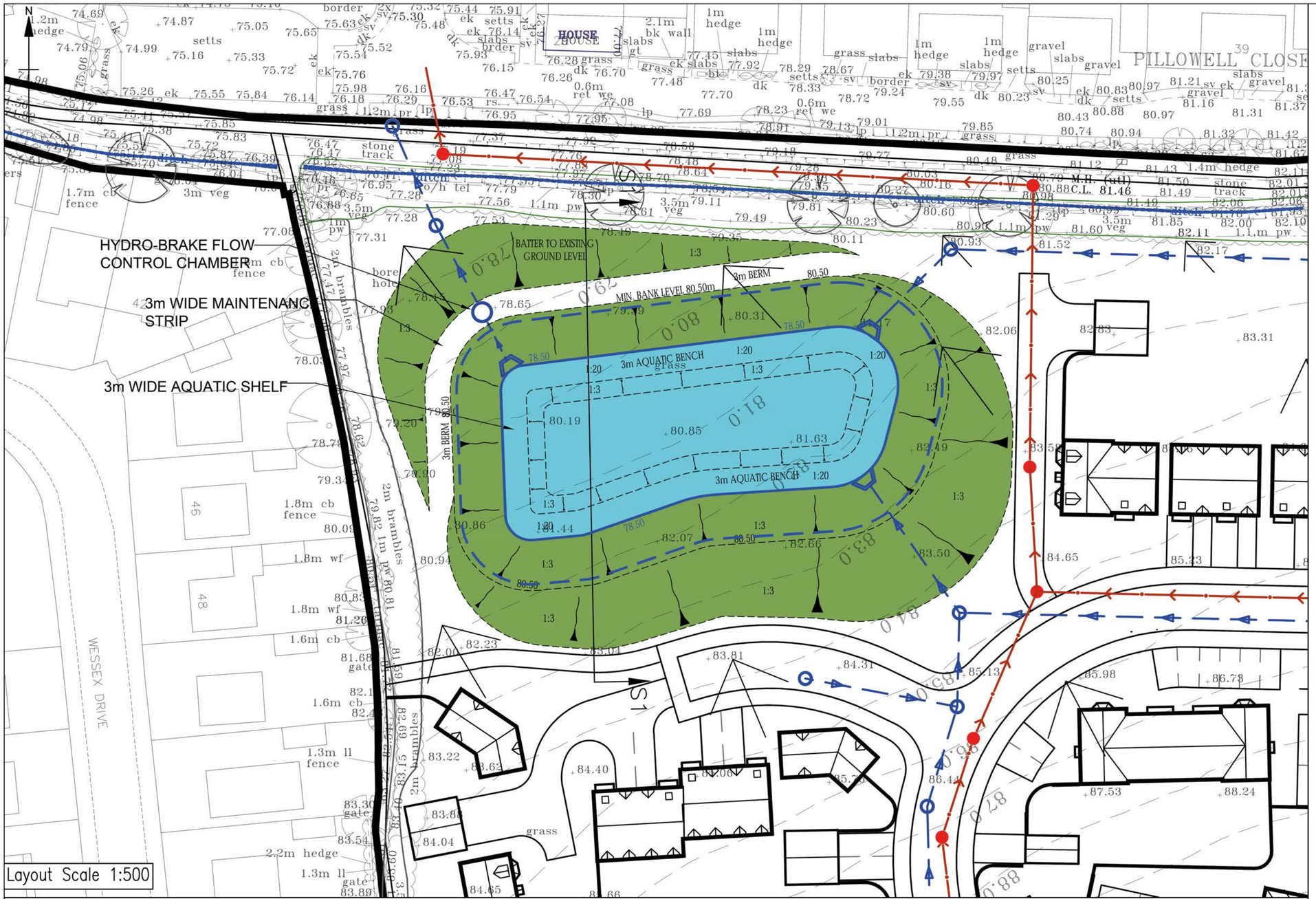
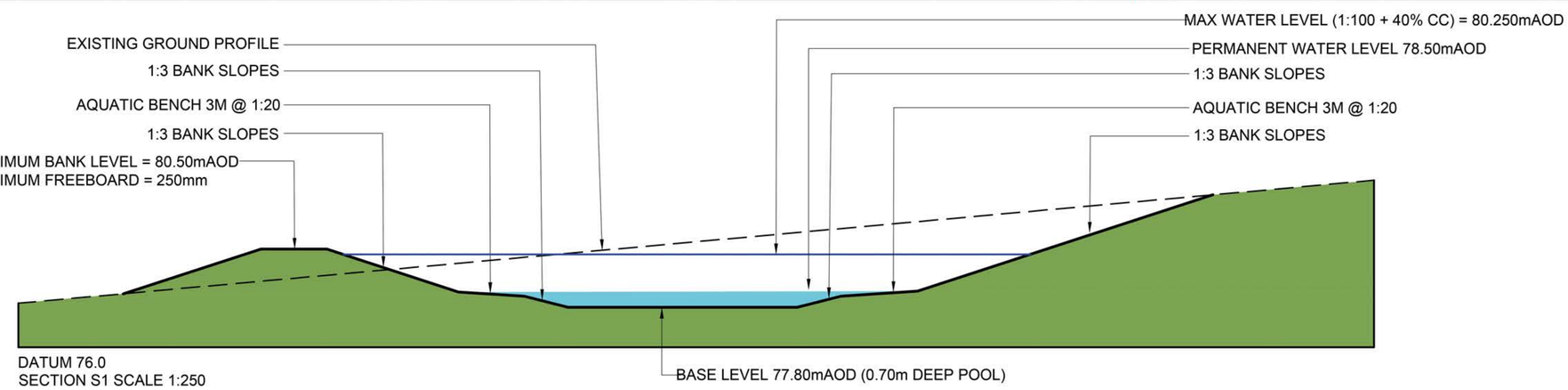
Drg.Status: PRELIMINARY

Appendix J

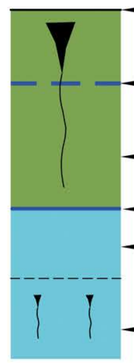
Drawing:

476-004 – Pond Details & Sections





POND DETAILS



Revisions

Project: Oakley Farm, Battledown
Cheltenham

Client: RobertHitchins
The Complete Development Solution

Drawing: Attenuation Pond Details

Scale: As Shown @ A3 | Date: October 2019 | Drawn by: MJH

Drawing No: 476-004 | Rev: -

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Drg.Status: PLANNING

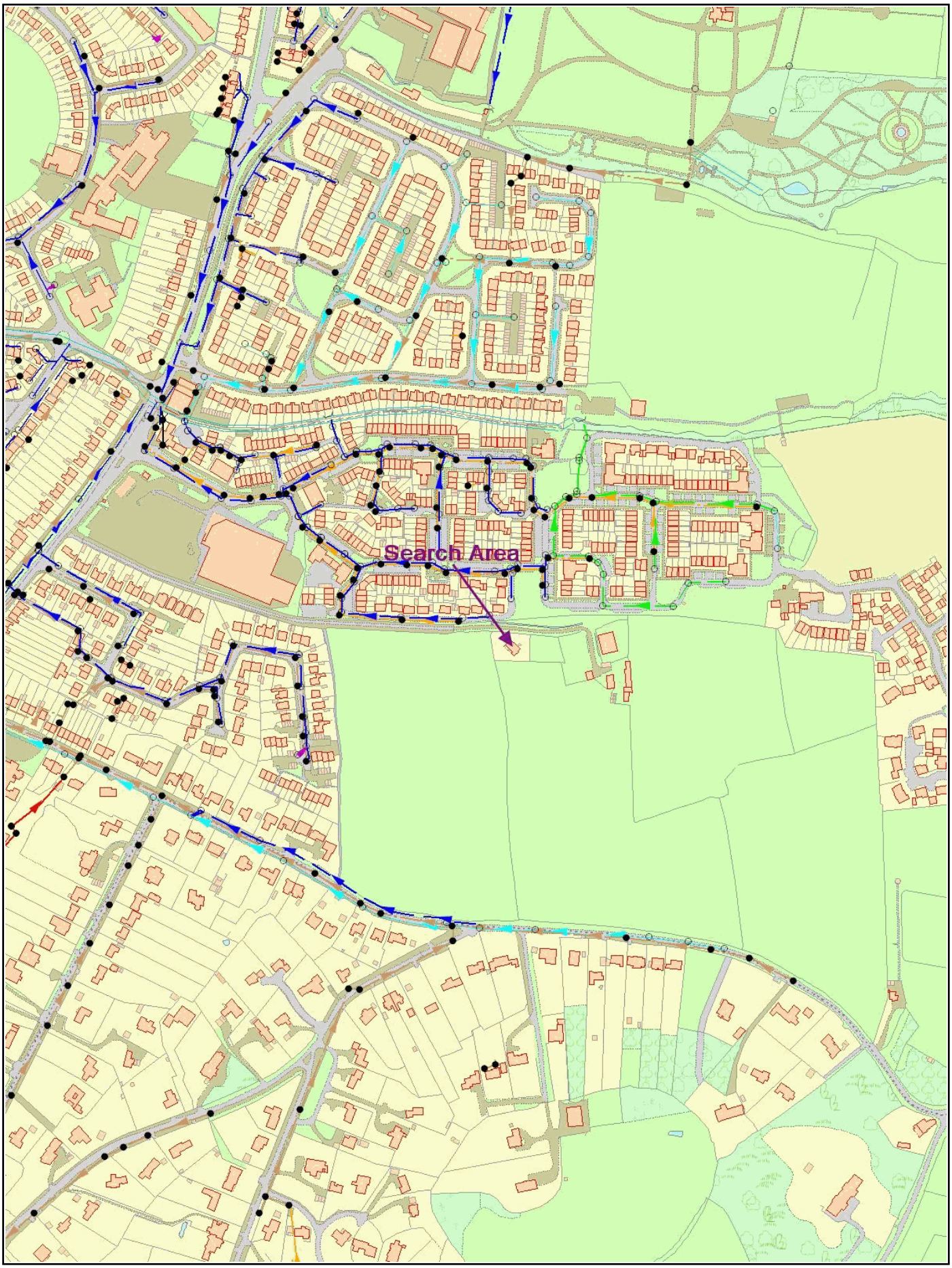
Appendix K

Severn Trent Water Asset Map

Severn Trent Water Limited, Severn Trent Centre, 2 St John's Street, Coventry, CV1 2LZ

Date of Issue: **29 June 2018**

SEWER RECORD as shown edged red on plan Oakley, Oakley Farm, GL52 5AQ



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